



PACIFIC SCIENTIFIC COMPANY
Manufacturing Facility, Anaheim, California

ENGINEERING INVESTIGATION NO. 101

REPORT ON THE PERFORMANCE
FAILURE OF P/N 1201133-TO, S/N 109

TEST CONDITION

20,000 feet, 300 knots, dummy test drop. July 16, 1964

TEST RESULT

Failure of drogue parachute release and main parachute deploy.

CAUSE: Power cables were not actuated.

This occurred because the mechanism portion of the actuator did not function. It failed to operate because the internal arming lever was not released by its cam which is controlled by the external arming lever. The external arming lever is required to perform as follows:

1. Reset Position -- 37-1/2° cw from vertical. At this "R" position there is a detent.
2. Locked Zone -- 20° ccw from "R" position -- Mechanism must remain locked and inoperative when lever is in this position.
3. Released Zone -- Lever movement must arm the unit for automatic operation in the remaining 17-1/2° ccw travel to the vertical position. At this "A" position there is a detent.
4. Overtravel -- For 37-1/2° ccw from the vertical position (or 75° from "R") the lever travels free after arming for automatic operation.

The installation of the two units in the pack is as follows:

1. P/N 1201134 is used for drogue deploy.
2. P/N 1201133 is used for drogue release and main deploy.
3. The two units are mounted side-by-side with their reset-arm function being synchronized by a connecting link.
4. The connecting link is actuated by a short length of cable which is a permanent part of the pack. This is pulled by a longer cable with the red knob on the outer end and a quick disconnect on the other end inside the pack.

On file USAF release
instructions apply.



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5. For normal operation the cables pull the arming levers approximately 25° ccw past the "A" position (into the overtravel range). The disconnect separates at this point.
6. The link is stopped at approximately 25° when it strikes the spring tubes (arming stop).
7. The link is prevented from un-intentional return to the "R" position by a spring loaded pin that protrudes as the levers reach the "A" position (reset stop).

To meet the test schedule it was necessary to use parts from existing actuator assemblies. For this purpose Pacific Scientific Company was supplied with 5 of the original test units, P/N 1201119-0 and 3 of the most recent type units built, P/N 1201119-1. The primary differences between the "-0" and the "-1" units were a change from carbon steel to stainless steel gears and certain other mechanical changes caused by closer performance requirements. In changing the gears a tolerance analysis was made which resulted in lowering the overall height of the assembly by .030. From these "-0" and "-1" units some components were discarded and others added to effect a change from a single output (main) to a dual output (main and drogue release) with separate spring systems for each function.

The units resulting from the above combinations of parts all performed to the requirements of the new dual unit P/N 1201133. The units using all standard and current design parts were identified as 1201133-0, serial numbers 101, 102, and 103. The balance of the quantity built was comprised of the older parts. Because these older parts came from units known to the customer as "Test Only" they were identified as P/N 1201133-TO and carried their original serial numbers (when they were P/N 1201119-0), 205, 225, 226, 227, 109.

All of the units were properly inspected and performed satisfactorily within the limits of their requirements. What was not noted, however, was the fact that the 1201133-0 units released from reset to arm position at approximately 3° ccw past the 20° locked zone while the 1201133-TO units released approximately 16° ccw past the locked zone. Both types were in tolerance, but at opposite extremes. The -TO units were releasing at the very edge of the "A" detent. The difference was caused by the .030 height in the gear assembly affecting the timing of the cam and lever relationship.

Investigation of the photos of the test failure pack as well as examination of its main and drogue release actuator, P/N 1201133-TO, S/N 109 discloses the following facts:

1. The release lever was in the "A" position.
2. The unit had not released the power cables.
3. The gear train had run approximately 40% of its travel.
4. Upon removal of the mechanism from the actuator despite damage to its case the gear train was still functional.



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Comparison of the connecting link action on un-damaged packs showed that the release lever is invariably pulled to a position approximately 25° ccw beyond the "A" position. This assures that a normal unit would definitely be armed.

CONCLUSION

A recap of what possibly happened is as follows:

The test in question was made at 20,000 feet and 300 knots with the pack in an abnormal position. (No seat was used). The arming cable (red knob) was attached to a static line and the dummy was released from the aircraft into the air stream. This resulted in two conditions being applied to the pack. Either one, or a combination of both, could have caused the units failure to arm.

1. The high forces caused the arming cable to be withdrawn with exceptionally high velocity which caused the lever to rebound from its arming stop back to the reset stop.
2. Upon the dummy's hitting the air stream at 300 knots there was considerable deceleration. Under these conditions, it would have been possible for sufficient G force to have developed to drive the release levers back to the reset stop.

Regardless of how the arming levers were returned to the reset stop, it has been determined that in this condition this particular unit (S/N 109) would not have armed unless it were very close to the upper limit of its tolerance.

Subsequently, 3 similar test drops have been successfully completed using the 1201133-0 units which arm at the other end of the tolerance.

The 4 remaining 1201133-T0 units were returned to the factory and reworked so that they would release to arm at the low end of the tolerance (approximately $20^\circ + 3^\circ$). This was done by removing .030 from the (internal) arming lever to compensate for the difference in heights of the gear assemblies.

One static ejection test has been successfully made using one of these re-worked units (S/N 227).

The past history of these units has shown them to be extremely reliable in releasing the power cable once proper arming takes place. There is no experience of the gear train ever failing to complete its function once started. A foreign object could have fouled the gears, but there was nothing in the unit at dis-assembly, nor was there any brinelling of the tooth faces. The mechanism was free and workable after removal from its case. These facts lead to discounting the 40% gear travel noticed. The gear train probably momentarily started and stopped upon impact. If it had started upon descent, it would not have stopped unless jammed, and as mentioned above, this seems improbable.

RECOMMENDATION

The result of this investigation is to suggest that the customer change its



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actuator specification by reducing the arming requirement from an area of 17-1/2° to 10° past the lock zone. This will have no effect on the standard type of actuator, 1201133-0, because they have always been built to these limits. Additional inspection will be made as a precautionary move to guarantee this.

It is also suggested that the reset stop be made more positive, and be moved 10° into the overtravel zone.

RELIABILITY

Based on our findings in this investigation, the reliability of these units should be improved for the following reasons:

1. The mishap would not have occurred with production units.
2. The mishap has pointed out the importance of the rebound stop and its relation with the actual "arming point".

Another thing that should be pointed out is that this failure would not have occurred in the actual system because the seat separator would not impart as severe an actuation onto the red knob as was done by this test.

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Project Engineer



Engineering Manager

July 24, 1964

